Los Alamos Space Science Outreach Program (LASSO)

Program Description

The Los Alamos Space Science Outreach Program (LASSO) for FY01 is a collaborative ongoing effort between the technical community (NIS-1) and the educational community (STB/EPO) at Los Alamos National Laboratory. New Mexico contains a significant population of Hispanic and Native American people, traditionally underrepresented in scientific and technical vocations. LASSO contributed directly to LANL efforts to reach out effectively to this population. Focusing on current NASA projects exploring the composition of the solar system, the LASSO project realistically affected the educational community of rural New Mexico and the nation as a whole by enhancing science content knowledge, providing current science curricula, and decreasing isolation factors for teachers in rural areas. The program provides current science curricula and decreases isolation factors for teachers in rural areas through the World Wide Web (http://set.lanl.gov/programs/lasso/) and electronic communication models.

The LASSO project engages professional learners in sustained classroom activities directly tied to the NASA-LANL space science programs thus supporting improved science, math and technology content knowledge as well as life-long learning process skills. The LASSO science education effort adheres to an effective instructional model based on education research and cognitive theory. Through this program students and teachers engage in activities that encourage critical thinking, a constructivist approach to learning, research, reflection, cycles of inquiry, and iterative assessments over the life of a project.

The educational component of this project involves master teachers representing secondary and elementary school levels in the development of multidisciplinary/multilevel classroom lessons and activities that focused on the NASA projects through a collaborative, distance learning process. The master teachers enhance their use of computer technology through the development of skills in Web page creation, concept mapping, and Internet research. The teachers interact with LANL mentors throughout the program.

During the program, teachers critically investigate the LASSO projects through the examination of basic and advanced science concepts behind the project goals. LANL mentors from NIS-1 collaborate with the master teachers providing current science content, motivation and support. The master teachers learn how scientific data is collected, analyzed and interpreted. They learn effective instructional methods that are incorporated into effective Web-based lessons and activities published on the LASSO educational Website.

The master teachers continue collaborative efforts through telecommunications during the research and development phase. They participate in a culminating activity where they finalize and deliver their Web-formatted lessons and activities for the LASSO Website. Their final products were delivered at the end of the final summer session and the developed Web-based lessons are added to the LASSO Website.

Goals

The LASSO program leverages Los Alamos National Laboratory's scientific capabilities and

resources by integrating current research in the area of space physics. The LASSO project supported the NASA education mission by aligning with the following:

- To increase public understanding of the issues relating to the future of space exploration.
- To develop the connections between scientific concepts and everyday life.
- To increase understanding of the science process.
- To provide opportunities to develop and apply critical thinking and problem-solving skills on complex problems of scientific significance.
- To promote cooperative learning through successful teamwork.

Project Objectives

The LASSO project was designed to enhance the overall quality, scope, and realism of science, mathematics, and technology education in New Mexico schools by

- Increasing teachers' and students' knowledge of the science, math and technology involved in space physics;
- Enhancing teachers' skills in teaching the content of earth and space sciences, and the new exciting technologies;
- Providing hands-on activities and materials to utilize in the schools;
- Exposing teachers and students to the application of earth and space science to current and future research projects at national laboratories;
- Providing a mechanism for teachers to encourage students to pursue careers in earth and space science.

Implementation Strategy

A select team of 20 master teachers, representing secondary and elementary school levels in northern New Mexico and west Texas were selected to participate in workshops held at Los Alamos National Laboratory. The master teachers worked together with Laboratory scientists to develop appropriate curricula for their educational communities. Scientists participated in the workshops by identifying basic concepts of space and planetary sciences while introducing new technologies behind current and future explorations. The teachers developed and implemented appropriate activities in their classrooms. The teacher-developed, scientist-directed, student-oriented units were inquiry-driven and modeled sound pedagogical practices. These practices included the constructivist learning theory, cooperative and collaborative learning relationships, and the integration of mathematics, science, and technology content. The teacher-prepared material was published on the LASSO Website thus impacting a wider community.

Program quality was assured in the following ways:

Workshops

The LASSO program was designed to match Laboratory expertise with the needs of schools in New Mexico to provide a unique educational opportunity tied to the NASA mission. Los Alamos National Laboratory program staff met with teachers in a series of workshops to develop and promote an effective curricular approach. The workshops demonstrated provisions of instruction for teachers in process and content, and the application of resources that required the teachers to sharpen their critical thinking and problem solving skills on current real space science projects.

Teachers were required to demonstrate their learning and understanding through various tasks that combined content information, research, critical thinking, problem-solving and telecommunications skills.

Products

Each teacher was part of a team that produced dissemination products based on his/her work on the project areas. The teachers examined specific projects as conducted by the NIS-1 group, and worked to develop educational products. These educational products included grade-level specific lessons and activities. Products were produced for the elementary, middle school, and high school levels. Examples from the new lessons and activities include "Solar Detectives," "No Picture," "No Sound," "Space Science Web Quest," "Satellite," "Solar Folklore," "Changing Flavors: Unravelling the Mystery of Solar Neutrinos." Others are listed on the LASSO Website and can be accessed at http://set.lanl.gov/programs/lasso/standards.html.

Demographics

Table 15 represents the breakdown of the participants by gender, ethnicity, location, population served, and academic level taught.

Table 15. LASSO Demographics

Gender Breakdown:			
Total male participants		6	30%
Total female participants		14	70%
	Total	9	100%
Ethnicity Breakdown:			
Total Caucasian		12	60%
Total minority		8	40%
	Total Hispanic	7	35%
Location Breakdown:	**Population served**	**Level**	
Bernalillo	Hispanic and Anglo	Elem., Secondary	
Rio Rancho	Native American, Hispanic, and Anglo	Secondary	
Tucumcari	Hispanic and Anglo	Secondary	
Los Alamos	Anglo, Asian, and Hispanic	Elem., Secondary	
Mora	Hispanic and Native American	Elem.	
Mescalero	Native American	Elem.	
Los Lunas	Anglo and Hispanic	Elem.	
Floyd	Anglo and Hispanic	Secondary	
El Paso	Anglo and Hispanic	Secondary	
Santa Fe	Anglo and Hispanic	Elem.	
Newcomb	Anglo, Hispanic, and Native American	Secondary	
Crownpoint	Native American	Secondary	
Lovington	Anglo and Hispanic	Elem.	
Las Cruces	Anglo and Hispanic	Secondary	

Table 16. LASSO Milestones

LASSO Milestones		
March 2001	Recruiting FY01 cohort	Active recruiting ongoing
July 2001	Workshop #1 – Science Content	Conducted July 9–12, 2001
July 2001	Workshop #2 – Pedagogical Content	Conducted July 16–19, 2001
August 2001	Workshop #3 – Wrap-up	Conducted August 6–9, 2001
August 2001–April 2002	Program implementation and report follow-up	Current implementation stage

Evaluation

Evaluation was composed of a combination of formative and summative strategies. A variety of evaluation tools were used to measure how well the program met its objectives. These evaluation tools included process feedback forms and teacher surveys. Follow-up activities are conducted throughout the academic year as teachers implement a variety of LASSO lessons. Teachers are expected to evaluate their implementation through evaluation of student papers, student presentations, and student-prepared products. The teachers submit final reports during the spring semester.

Review of the teacher surveys showed that the project was successful in meeting its overall goals. The teachers enjoyed interacting with each other during the LASSO workshops while conducting their research and completing their LASSO lessons and activities. Teachers generally agreed that the students learned a lot about the topics.

Evaluation of the program using a variety of tools and methods revealed that students and teachers demonstrated positive increases in the following areas:

- Understanding of space physics
- Content understanding in the monitoring of space phenomena
- Understanding of telecommunications
- Use of technology for research purposes
- Ability to use the computer to communicate and share information with others
- Ability to research a complex issue
- Use of concept mapping
- Understanding of content by using a problem-based approach to learning science
- Small-group work

Program Highlights

The first workshop (Table 16) was held the week of July 9, 2001, at Los Alamos National Laboratory for twenty master teachers to begin developing classroom lessons and activities that support the LASSO curriculum efforts in the area of space physics. Teachers were immersed in the varying NIS-1 projects included in the LASSO effort. Project scientists discussed some of the basics included within their research. Seminars included lectures and demonstrations on particle physics, charged particles, and electromagnetic fields. Further studies acted as a background for advanced sessions on the solar wind and Earth's magnetosphere.

The second workshop was held the week of July 16, 2001, at Los Alamos National Laboratory. Twenty master teachers representing 14 NM school districts and 18 individual schools participated in the summer institute. The teachers engaged in the development of curriculum as well as establishing a communication network that would be utilized in the program to share

and disseminate curriculum ideas, thus reducing their isolation from the rest of the educational community. Los Alamos National Laboratory scientists participated as content mentors and offered a varied cross section of opinions and experiences within the space physics arena.

The final workshop was held the week of August 6, 2001, at Los Alamos National Laboratory. There were 18 schools, 20 teachers participating with 4 high schools, 4 middle schools, and 10 elementary schools represented. The projected overall student enrollment supervised by the twenty teachers was approximately 1200.

The master teachers used the Los Alamos National Laboratory Critical Thinking Curriculum Model (CTCM) and the Web Quest curriculum model developed at San Diego State University. The CTCM is a multidisciplinary approach to learning, encompassing computer technology, current real-world issues, and proven learning and teaching practices. This model features open-ended and collaborative activities and is designed as a project-based research experience for students and teachers to develop a conceptually correct understanding of the topic being studied.

Teachers became very comfortable using technology in the classroom, and it was expected that their students use the technology as part of their class.

Teacher Comments

"The LASSO program has helped me do my duties as a teacher in the computer age more effectively. The program has given me the ability to take my class to the next level as far as using the available technology. The Internet has become a useful educational tool in my classroom instead of a just a "toy" for the students to use as a reward. The workshop gave me the knowledge and experience I needed to make a true educational web site where students are asked to do and learn instead of just look or read. The workshop afforded me the opportunity to collaborate with other science teachers. I learned from what they are doing or have done in their classes."

"The LASSO program that I participated in the summer of 2000 was a great benefit to myself as well as my students. I benefited as a teacher and as a person interested in science. My students gained an appreciation for space science and self esteem."

"The LASSO workshop I attended in the summer of 2001 was a tremendous benefit to my knowledge base. My first teaching field is in biology. My knowledge of space science was limited at best. I teach at a small rural school that only has one science position. Because of this I teach all the high school science courses at our school. The LASSO program has given me the opportunity to expand my knowledge of space science in a way that no college course could do. I learned about what was happening on the cutting edge of technology and about programs that were only months or years old instead of decades. I was exposed to the knowledge and experience of scientists that are involved in one of the top space science programs in the world. No college class could compete with what I learned at the workshop."

The real benefit of the LASSO program was to my students. I named my project the Magnetosphere Project. The students were from my 9th grade physical science class. The class consisted of 20 ninth grade students. The learning curve was expediential. The first day of the project I asked the class how many had heard of the magnetosphere. The response surprised me. Not one student had even heard of the magnetosphere. The students did have some background knowledge of astronomy but knew very little about space science and any programs that involved the study of our solar system. By the end of the five-week unit the students were "magnetosphere experts." They could explain

the characteristics of the magnetosphere as well as how it and why it is studied."

"The project had a great effect on my students in the area of self-esteem. One of the greatest outcomes of the magnetosphere project is that the students know they learning about something that very few people in the world have any understanding about. This gives the students a sense of pride and builds their self-esteem. The students built models of the satellites and the magnetosphere. They were able to explain how the magnetosphere affects all areas of society. They also realized how much technology we use in our everyday lives is a direct and indirect result of the study of space science."

"The LASSO program at LANL is a much-needed resource to all science teachers. I am so busy with teaching that I have little time to research what is going on in the science world. The program puts me in touch with real scientists. I could never learn what I did attending the LASSO workshop in a college classroom. The students are the real winners. They get to learn about science that is happening today, not ten years ago. They learn about ideas and programs that affect them today and will affect them in the future. They have the opportunity to learn about something that most people have not even heard of. This builds on their self-esteem and pride. I think in the long run the LASSO program will have an effect on how students view science, the space programs, and themselves."